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ABSTRACT

These two slide scripts, part of a series of slide scripts designed for use in vocational agriculture classes, deal with scaling and grading hardwood logs and lumber. The first script includes narrations for use with 39 slides, which explain the techniques of scaling and grading hardwood logs, and the second script contains the narrations to accompany a set of 34 slides illustrating the principles of hardwood scaling. The package also includes information on the specific educational objectives of courses in forestry, natural resources, and production agriculture that are addressed in the scripts. (MN)

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HARDWOOD LUMBER SCALING

and
HARDWOOD LOG SCALING AND GRADING

D.E. Wooten
Robert D. Touse



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FOREWORD AND ACKNOWLEDGMENTS

Hardwood Lumber Scaling was developed by D.E. Wooten, Sawmill and Logging instructor at Buckeye Hills Career Center, Rio Grande, Ohio and instructor at Shawnee State Community College in Portsmouth, Ohio. The author's educational background includes degrees from the University of Cincinnati, Ohio College of Applied Science, Cincinnati Technical College, and The Ohio State University in the areas of Forestry, Horticulture, Natural Resources, and Agricultural Education. He has also worked and taught in the sawmill and logging industry in Ohio for a number of years.

This slide set contains 34 slides, an illustrated script and a suggested lesson plan. *Hardwood Lumber Scaling* is the third part in the *Hardwood Forest Mensuration* series. Part one is *Timber Cruising*; Part two is *Log Scaling and Grading*. Each part is designed to be a valuable classroom teaching aid. The purpose of this presentation is to provide an organized, informative approach to the various scaling and grading skills. Students will need these skills for entry-level employment in the timber industry or for self-improvement in woodlot management or timber sales.

Project directors were Roger D. Roediger and A.W. Welch. Senior project consultant was Robert D. Touse, Professor of Natural Resources at The Ohio State University. John Miley, District Supervisor of Vocational Education, also consulted on the project. Photography was by D.E. Wooten and Roger D. Roediger; graphic artwork was by Jerry King. Muriel King provided editing and Jacqueline Rehm provided phototypesetting and layout of the slide graphics and script.

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Planning for the Slide Series
HARDWOOD LUMBER SCALING

Classes for Which the Slide Series Is Intended

Forestry, Natural Resources, and Production Agriculture

Idea or Overall Purpose of the Slide Series

To promote more interest in and knowledge of lumber scaling

Specific Educational Objectives

1. To teach students to estimate accurately board footage (B.F.)
2. To develop lumber scaling skills
3. To develop proficiency so that students are capable of keen competition in local, district, and state contests.

This slide series is designed to be accompanied by classroom testing, laboratory demonstration and laboratory experience.

HARDWOOD LUMBER SCALING



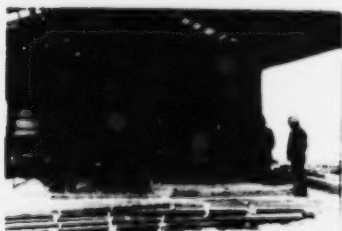
1. Title slide



2. Lumber scaling is the measurement or estimation of the number of board feet in lumber. A board foot is a unit of lumber measurement one foot long, one foot wide, and one inch thick, or its equivalent.



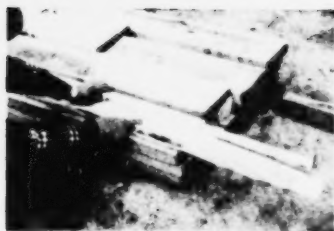
3. Students skilled in lumber scaling may find jobs in sawmills and with building supply companies. The proficient lumber scaler may advance into lumber grading. Lumber scaling is widely used by both sellers and buyers. Forest managers and park management personnel may also need lumber scaling skills.



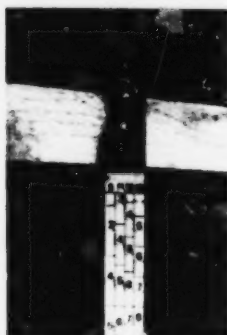
4. These students are being trained for a skill that is in demand in today's sawmill industry.



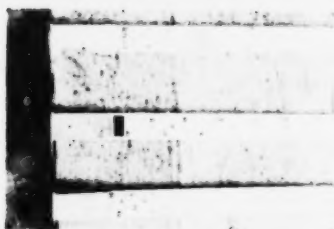
5. Here is the payoff — this skilled student is employed, makes money, has job security, and has the opportunity of advancement into lumber grading.



6. A lumber rule is a basic tool in this industry. There are several basic steps in using the lumber rule to find the board feet (B.F.) in a board. Let's look more closely at a lumber rule.



7. This is the "head" portion of the rule. Notice:
- the function of the head
 - the thickness values
 - the length values
 - the B.F. (board feet) values



8. In these rules note the variation in:
- head design
 - arrangement of numbers
 - number of lines on rule



9. This is the "handle" portion of the rule. Notice that the numbers 8, 10, and 18 on the bottom rule indicate the length of the board.



10. The numbers 12, 14, and 16 are the board lengths on the other side of the rule handle. This particular rule would be described as an even-length, 3-lined lumber rule.



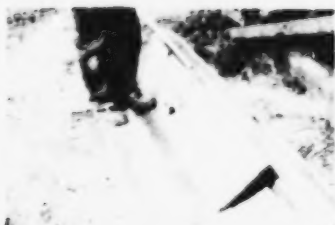
11. Note the characteristics of these three lumber rule handles.
- a. **top rule** — for odd-length lumber
 - b. **middle rule** — 3-lined, even-length lumber rule
 - c. **bottom rule** — 4-lined, even-length lumber rule



12. There is another variation in lumber rules. Some are used with dry lumber and some are used with green lumber. With green lumber measurements the numbers are farther apart to allow for lumber shrinkage. Board footage numbers are arranged horizontally (according to the length of the board).



13. These B.F. values are calculated according to the formula shown here.



14. The lumber scaler is shown flipping the board to see both sides and thickness of the board. The National Hardwood Lumber Association (N.H.L.A.) designates that lumber must be scaled and graded on the worst side.



15. The lumber scaler has found rot on one end of the board's underside —rot that didn't show on the upper side. This will reduce the length of usable lumber in the board.



16. Flipping this board has revealed another reduction in the length of usable lumber. This is excessive end slab, which should have been end-trimmed.



17. Another cause for board feet reduction is wane. Wane is bark that is left on the edge of the board, causing a narrow area in the board. The board is normally scaled at its narrowest point.



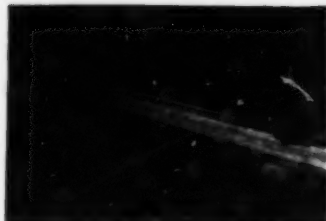
18. This student is finding the length of the board. He starts at the most sound (solid) end of the board with his lumber rule.



19. He takes care to pivot the rule's end on the board so he won't lose his place. (The lumber rule is 3 feet long tip-to-tip).



20. This board is a correct standard length with an extra 2 to 6 inches of end-trim to allow for split, rot, end-checking, etc.



21. This board is undercut, and not long enough to sell as a standard length. This is actually the fault of the logger who bucked the log too short. But you own it now and you won't be able to sell it.



22. The scaler is shown measuring the thickness of the board. Note: All board footage values on the rule are for 4/4 (4-quarter) or one-inch lumber.



23. This illustration shows that the B.F. value is correct for 4/4 lumber, but must be multiplied by 2 to get the correct B.F. value for 8/4 (8-quarter) or 2-inch lumber.



24. The scaler is shown using the lumber rule to measure the width and B.F. of the board. Note that the rule is made of hickory. These rules may be flexible, but it is possible to break them.



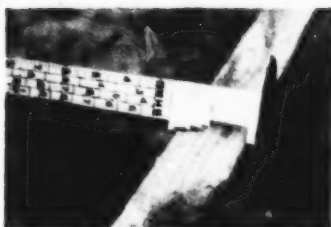
25. When reading the rule:
- Scale the board at its narrowest width.
 - Don't record $\frac{1}{2}$ B.F. numbers. Go to the nearest whole number.

You tally the nearest whole number as B.F. value.





26. The board is measured at the narrowest part. The wane (bark) will be a scalable defect that reduces width and B.F. of the board.



27. Here the student is scaling 8/4 lumber and will have to double the B.F. number shown on the lumber rule when entering it on the tally sheet.



28. When scaling crooked or warped lumber, it is necessary to deduct the portion which is not straight and flat. If this results in a board that is too short to be merchantable, it is culled and scaled as zero.



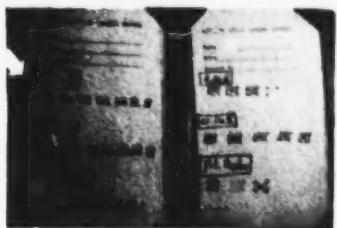
29. The blue stain in this wood should be your first clue that it contains metal. Closer inspection should reveal the shiny or rusty metal. This is usually considered a cull board because it is not workable or machinable. It may have already torn up equipment like a chainsaw, headsaw, edger or chipper.



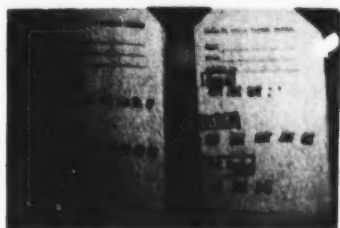
30. The hand-held tally book with thumb straps permits the scaler to hold the book in one hand and scale and write with the other. The book holds in the sheets and can be closed to protect the tally from weather.



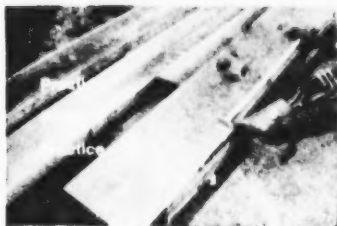
31. Note that the tally for all three species on the right-hand page is identical to that of the same species on the left-hand page, but the tally on the right-hand page takes half the space. The tally shown here is for student lab purposes and is for B.F. only. In a sawmill the same tallying system might be used with one exception: each mark or dot would indicate more than 1 B.F. It would probably indicate a specified standard species and dimension piece of known B.F.



32. This slide shows two ways to record and tally B.F. On the left, a line has been entered for each B.F. record. These lines are in groups of five.



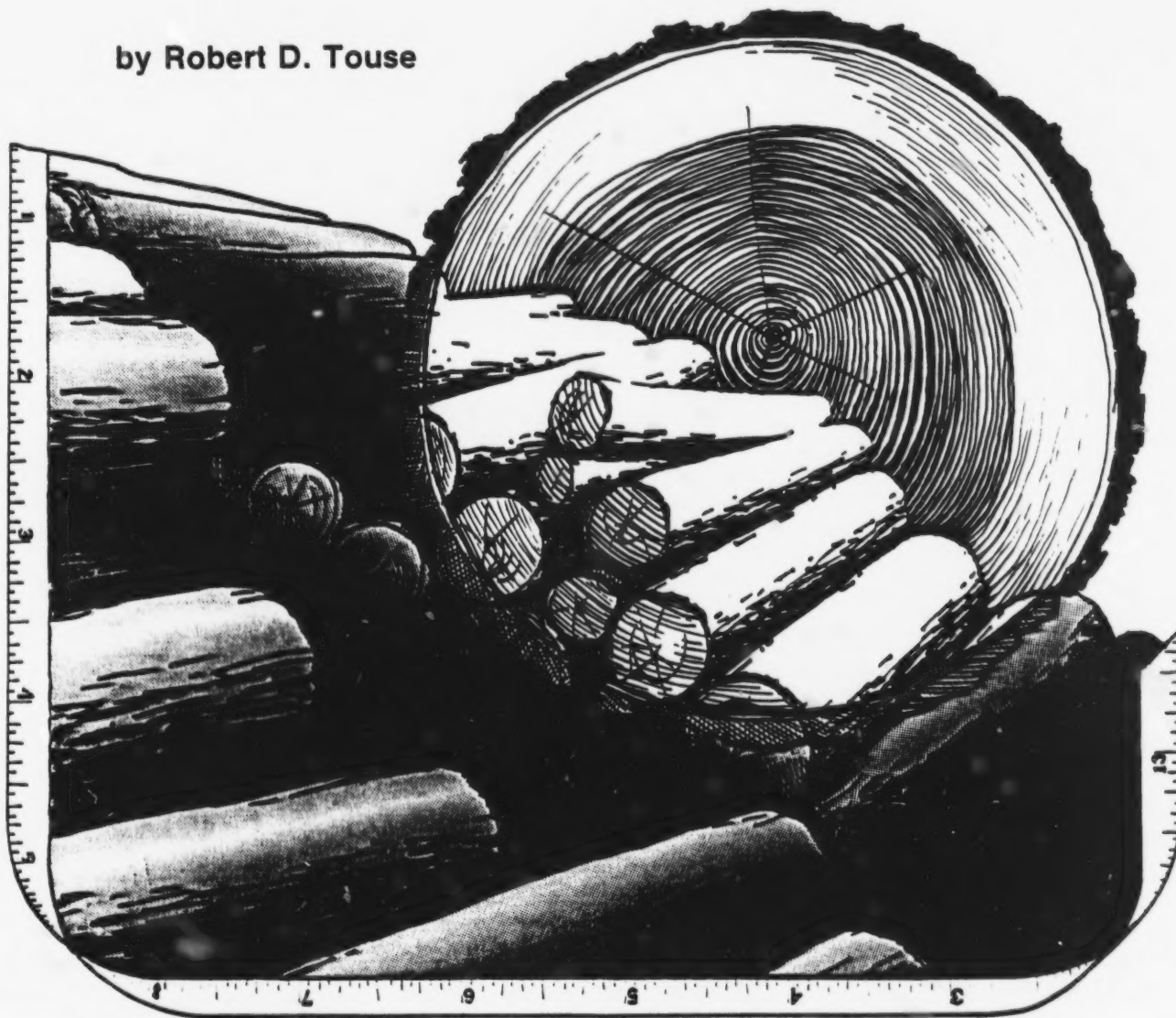
33. On the right, the dot and line tally system has been used. Four dots (in a square pattern) represent the first 4 board feet. The two lines forming the "X" which joins them are for the 5th and 6th board feet. The 4 outer lines, which form the square, represent the 7th, 8th, 9th, and 10th board feet. This system uses groups of 10 and is easily tallied.



34. In lumber scaling, as in timber cruising, experience is the best teacher. Now all you need is *practice, practice, practice*.

HARDWOOD LOG SCALING AND GRADING

by Robert D. Touse



OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE

Agricultural Education Service
State Department of Education

Department of Agricultural Education
The Ohio State University

FOREWORD AND ACKNOWLEDGMENTS

Hardwood Log Scaling and Grading was developed by Robert D. Touse, Professor of Natural Resources at The Ohio State University. The set, containing 39 frames and a script, is part two of the three-part Hardwood Forest Mensuration Series. The purpose of this presentation is to provide an organized, informative approach to the various scaling and grading skills. Students will need these skills for entry-level employment in the timber industry or for self-improvement in woodlot management of timber sales.

Project director was A.W. Welch. Project consultant was Roger D. Roediger. Cover artwork was by Jerry King. Muriel King provided editing and graphic work for the slides. Jacqueline Rehm provided the phototypesetting and layout of the slide script.

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HARDWOOD LOG SCALING AND GRADING

1. Title slide
2. Log scaling is the work of estimating how much lumber can be sawed from a log. Since lumber is measured in *board feet*, we will be estimating the yield of logs in board feet. The value of the log and the lumber is also determined by quality. Therefore, the log scaler is also a log grader.
3. All farm crops have some unit of measure associated with their market value. This unit may be a dozen, a bushel, a hundred weight, or even a thousand board feet.
4. This Ohio farm produces many different agricultural products. Logs are one of these products, along with forage crops, grain crops and livestock. Measuring and marketing timber is the same kind of business activity as measuring and marketing other crops.
5. We can measure very accurately the lumber sawed from this log. Estimating the amount of lumber before sawing is another matter. Logs are not round and are usually tapered. They are often crooked and are covered by bark. The log scaler must carefully consider all these variables.
6. The thickness of hardwood lumber is expressed in quarter-inches. "Four quarter" (4/4) boards are one inch thick. The board rule measures surface feet to the nearest board foot.
7. A New England log dealer named Doyle was among the first to propose a formula for estimating board feet of lumber to be sawed from logs. The **Doyle Log Rule** formula is $(D - 4)^2$ for a 16-foot log. It uses a direct proportion for converting to other log lengths. The Doyle Log Rule formula is:

$$\frac{(D - 4)^2}{16} \times \text{Length}$$

The scaling diameter used by Doyle was measured inside the bark at the small end of the log.

8. Many other log rules have been proposed. Among these are the **Scribner Rule** and the **International Log Rule**. The International Log Rule is preferred by the U.S. Forest Service and most state forestry agencies. The Doyle Log Rule, however, is preferred by most hardwood sawmill managers and is the most commonly used log rule in Ohio. For that reason our discussion will be confined to the Doyle Log Rule.
9. The preference for Doyle Log Rule scaling by sawmill people is uniquely eastern. By the time the lumber industry moved west, the U.S. Forest Service was promoting the Scribner and International Log Rules.
10. The various log rules such as Doyle, Scribner and International are often printed as tables in a book. It is possible to measure the scaling diameter with a yardstick and obtain the board foot figure from the table. One reason for doing this is that the Doyle Log Rule does not provide overrun on large logs. The scaler may wish to use Scribner or International values on larger logs.

11. The scaling stick which has International Log Rule figures looks just like the Doyle Rule stick. It is used in the same manner. The difference is the number read from the stick.
12. Some log scale sticks also have a tree scale printed on the back. Do not be confused by this. The tree scale stick is used on *standing timber*, not on logs.
13. When logs like these are scaled with the Doyle Rule, the figure is less than the actual lumber yield. In other words, more board feet of lumber will be sawed than the Doyle Rule estimate indicated. This difference is called the **overrun**. It is important to the sawmill manager.
14. The formula for International Log Rule calculations is much more complicated and more accurate than the Doyle formula. Because of this, it does not provide the overrun. When sawmill people are forced to purchase logs by the International scale, the price per thousand board feet must be lower.
15. Crooked logs yield less board feet of lumber than straight logs. The scaling stick placed against the small end of the log does not show this deductible defect. The scaler must quickly look at the entire log and make note of its soundness and straightness. Heart rot is another deductible defect which reduces board foot yield. The overrun provided by using the Doyle Rule usually offsets these deductible defects. If the scaler is not responsible for making the calculations for defects, the scaler's work is finished sooner. The scaler can then go on to other responsibilities.
16. Business people use log scaling as a tool for making money. The log scaler can process more logs in a working day than the sawmill can saw in that same time. The person who scales logs will also perform other important duties.
17. When trees are felled and cut into logs, each log must have 4 to 6 inches of extra length for trimming allowance. In other words, boards cut from the log must be long enough to retain the nominal length after the ends have been trimmed.
18. The nominal length of sawlogs usually increases in two-foot multiples from 8 feet. Walnut and some other very valuable species are often cut to one-foot multiples. If the log has been cut too short, it must be classified in the next shorter length category.
19. Sixteen feet (plus trimming allowance) is the maximum length to be scaled by placing the stick against the small end of the log. When 18- or 20-foot logs are scaled in this manner, taper introduces too much error. The tree-length logs on this truck will be cut into shorter lengths at the sawmill.
20. Timber buyers often purchase all the marked trees in a woodlot for a lump sum. The landowner is not paid by the thousand board feet and there is no reason to scale the logs at the landing. Hauling tree-length logs to the sawmill is a matter of economics.
21. Log scaling is the activity of estimating board feet of lumber to be sawed from a log. Bark along the edges of a board is called **wane** and is considered a defect. Most of the larger sawmills remove the bark before sawing. When scaling logs, the diameter is measured inside the bark.
22. Bark has good fuel value. Sawing clean logs keeps the saw sharp longer and increases lumber production. Pulp mills purchase the bark and sawdust for boiler fuel.

23. The taper of a log limits the width of boards sawed from it. Doyle and all his counterparts agreed that the scaling diameter of a log is at the small end.
24. Log scaling is most often done with a folding scale stick. The Doyle Rule is printed on both sides of this stick. A row of board foot values is printed for each log length. These lengths are indicated near the zero end of the stick. Inches of log diameter are marked with a line across the stick. The appropriate board foot value is printed adjacent to the diameter line. The stick is placed against the small end of the log.
25. The placement of the stick has much to do with the board foot scale you read. The body of the stick lies along the line of average diameter. The zero end of the stick is placed at the point where bark and sapwood join. The board foot scale will be read at the opposite side of the log.
26. The board foot scale for this log is read at the edge of the sapwood.
 - 27 board feet for a 12-foot log
 - 32 board feet for a 14-foot log
 - 36 board feet for a 16-foot log

This board foot value will be recorded in the proper section of the tally sheet.

27. We noted early in this lesson that the log scaler is also the log grader. The tally sheet should have a separate section for each log grade.
28. Hardwood sawmills must strive to produce the maximum amount of grade lumber from each log. This is not only good conservation, but an absolute must for profitability.
29. Veneer logs are set aside at the sawmill and sold to the veneer mill. They must be larger in diameter, longer, and more free of defects. Veneer logs will be sliced into thin sheets of veneer.
30. Trees often contain decay or heart rot. Logs which contain small amounts of decay may yield plenty of good lumber and be profitable. Some logs will not yield enough lumber to make sawing worthwhile.
31. Curvature in one direction is called **sweep**. Sweep is measured by drawing a chalkline taut between the ends of the log. The distance from the string to the surface of the log is divided by the scaling diameter and expressed as a percentage.
 - Veneer grade must not exceed 10% sweep.
 - Sawlog grade #1 must not exceed 10% sweep.
 - Sawlog grade #2 must not exceed 15% sweep.
 - Sawlog grade #3 must not exceed 20% sweep.
32. Crook and shake are two defects that affect the grade of logs. **Crook** is curvature of the log in two directions. **Shakes** are separations between annual rings. Any log which has serious crook or shake must be graded #3.
33. As a general rule, increased quality comes from larger diameters and greater lengths.
34. The next step is to visualize the log divided into four faces, as it could be sawed. The face containing the most defects is used as the grading face. The other three sides of the log will have fewer defects.

35. The grade of the log is determined by the amount of clear cutting area in the grading face. This requirement is expressed as a fraction with 12 as the denominator. *Example:* 10/12 for grade #1. To determine the number of clear cutting inches required in the grading face, the length in feet is multiplied by the numerator. *Example:* A 16-foot log must have 160 (16 X 10) inches of clear cutting area to be graded #1.
36. Any defect in a log, such as a knot, stops clear cutting at that point. The log grader may not think of ripping and cross cutting as the lumber grader is permitted to do.
37. Here is a close-up of one of these stoppers. This knot will show up in each board cut from this face.
38. The clear cutting requirement is further limited by a maximum number of cuttings and a minimum length of cuttings.
39. We have now developed a very simple set of log grading rules. Most log graders use a similar set of rules. The U.S. Forest Service has a well-developed set of log grades which are based on years of research. For further study in this field, refer to the U.S.F.S. rules.